

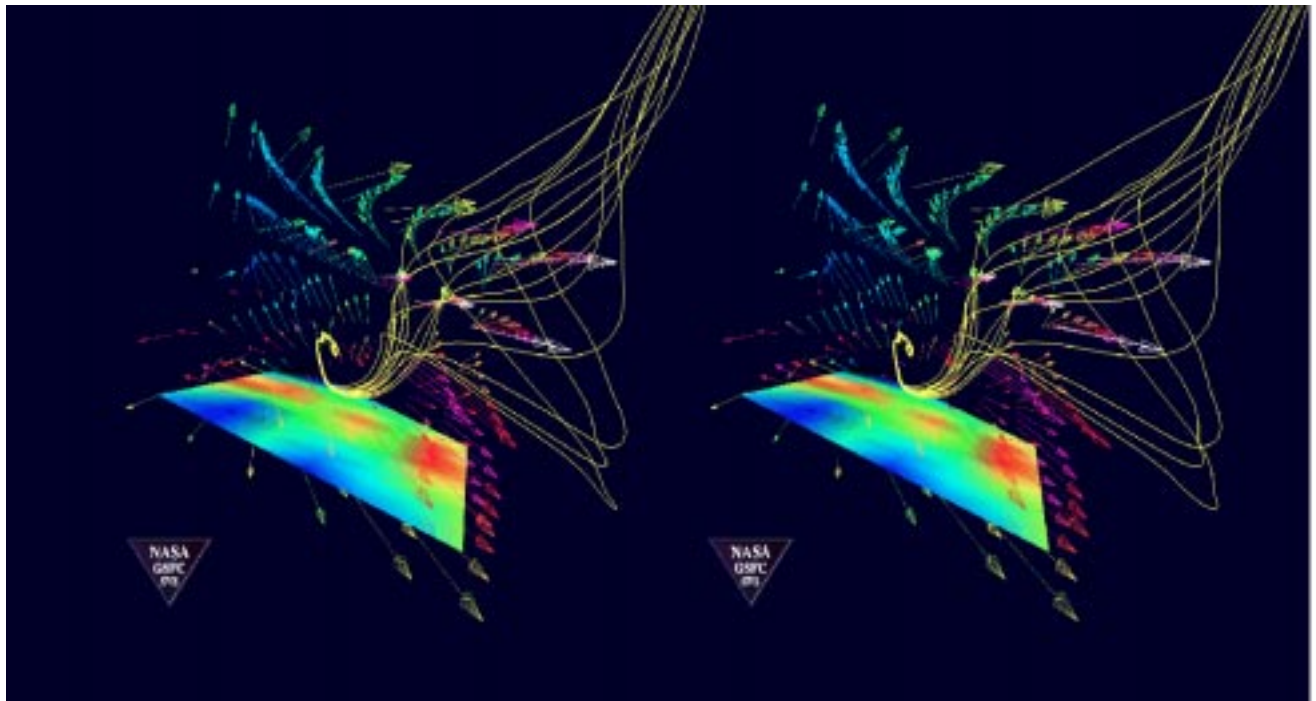
Stereoscopic Visualization and Analysis of Space Science Observations and Simulations

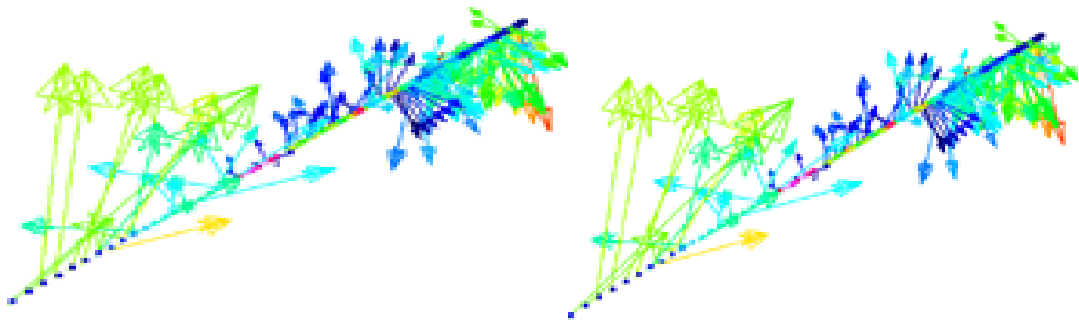
*Bringing the power of simple, practical “virtual reality”
methods to desktop computers*

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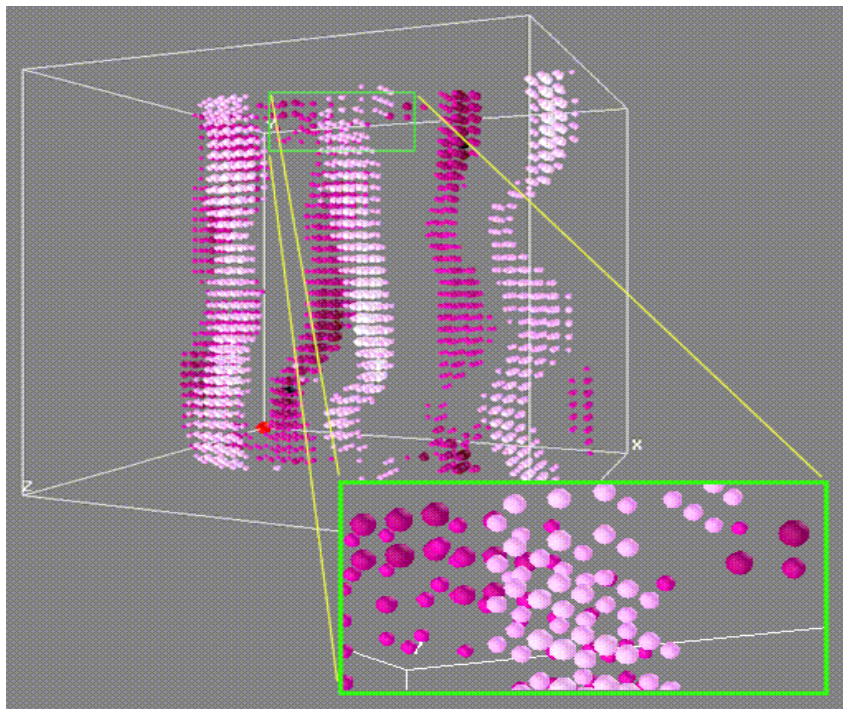
- New methods for true 3-D visualization using “glyphs” and a hand tracker interface in addition to traditional methods will provide desktop access to powerful new ways of visualizing data.
- Current target data sets include simulations of fluids (see magnetic field vectors and streamlines below), and multi-spacecraft time series visualized in their actual relative locations, but the techniques are general and will work for many multi-deminsional data sets.





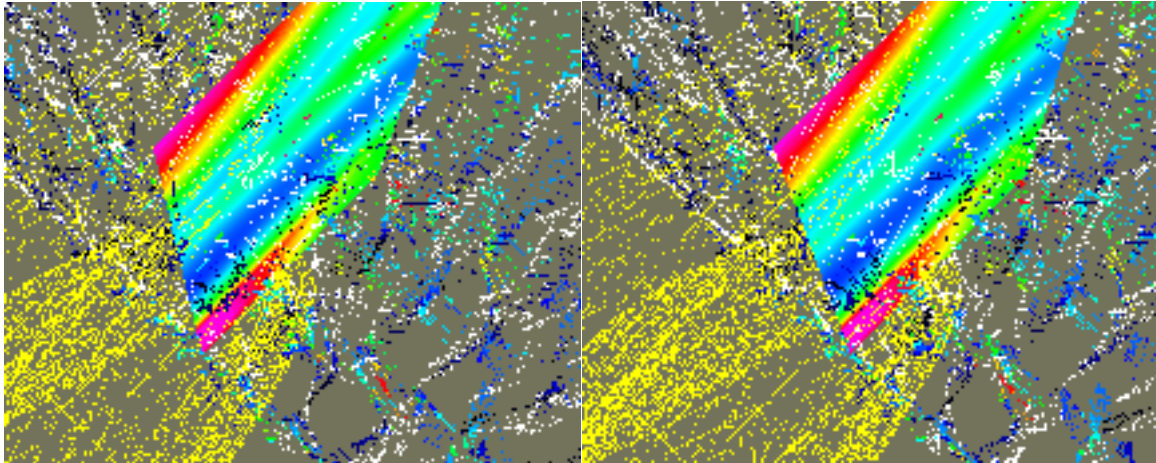
Spacecraft Data Visualization

The figure shows a time series of magnetic field vectors near a “sector boundary” where the field reverses colored by the local temperature and with density given by the colors on the axis. The (parallel) stereo gives a totally different view of the data from the traditional line plots. Data from many spacecraft could be displayed in the 3-D location it was measured to reveal global connections in a direct way. Data measured at many points may be subsetting according to various criteria to search for patterns not otherwise readily discerned.

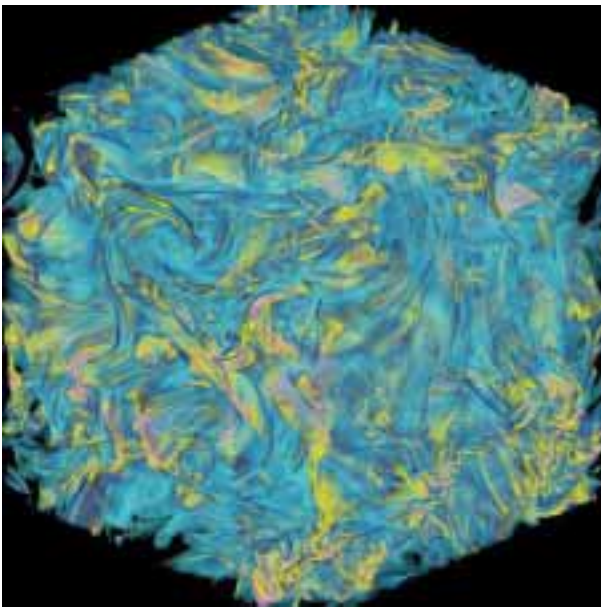


Data Representation

To make the visualization efficient and the interior of the volume accessible, we use “glyphs” (symbols) at each point. The information can be in the size, color, shape, orientation, opacity, or other properties of the glyphs. Shown here are spheres whose size and color represent the magnitude of the quantity (here, “vorticity” in a fluid flow), cones oriented along a vector direction with the color giving the magnitude, and arrows showing vectors colored by magnitude. Many other possibilities exist, and we are experimenting to maximize information content and efficiency.

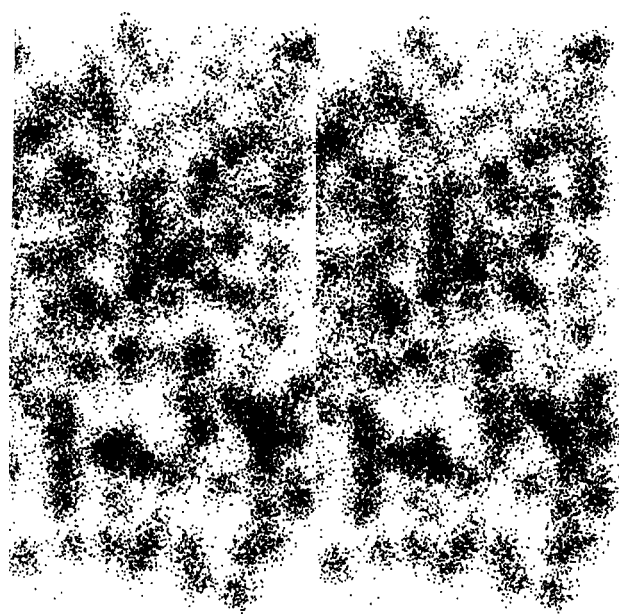


Complexity: Stereo allows the visualization of complex data (here of a simulation of a shocked fluid). The addition of the third dimension allows a greater information density on the screen, as well as the use of meshes and glyphs that are incomprehensible without the depth.



Other Methods

This figure shows a “volume rendering” of gaseous fluid flow in a 512^3 grid point simulation from the Minnesota Supercomputer Center. The time to render for this 512×512 image was 3.3 seconds using 128 T3D processors. Although at times quite useful, this is a very time consuming method, and it does not allow us to see into the volume effectively.



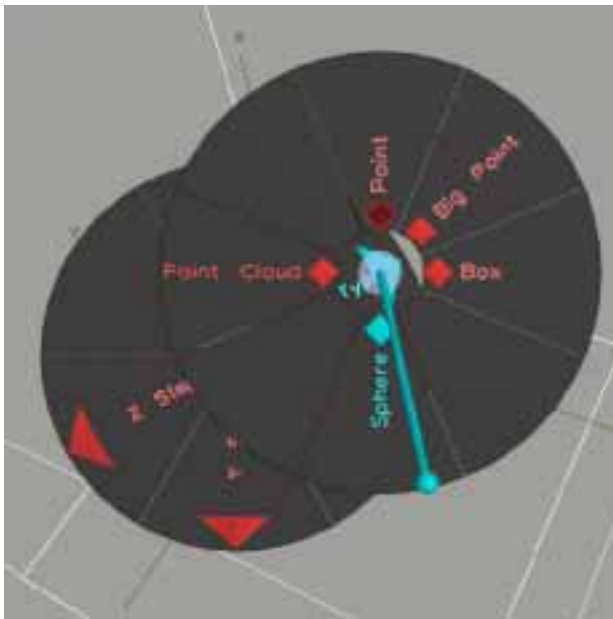
New Methods for Visualization

The use of stereo allows new ways of thinking about visualization. Shown here are “clouds of points” that show up as a maze in 2-D, but when viewed in (parallel) stereo, the 3-D structure becomes clear. The points could represent physical objects, such as stars in galaxies, or their density could represent the value some scalar quantity (density, pressure, temperature, etc.). The points make it possible to see into the volume, and they are easy to render.



User Interface

Our main focus for the user interface is that shown here in which the user wears liquid crystal glasses that allow the viewing of left and right eye renderings alternately to produce the stereo, and in which two hand held sensors allow the rendered volume to be rotated, panned, zoomed, subsetting, etc. The sensors will have buttons on them to choose the various functions. One of the sensors will bring up the “sundial” menus shown in the accompanying figure. These make it possible for the user to perform functions such as loading files or rescaling glyphs without having to leave the stereo environment.



Activities and Directions

- Continuing the development of the stand-alone program. Basic Open-GL/Motif port complete. Need to add features and improve aspects of the interface.
- Started dialogue with IBM to add a stereo module to Data Explorer and to determine how to add the interactive features of SFA.
- Began investigating 3-D input devices with the aim of making a prototype for an easy-to-use, inexpensive, noise-free device.

Summary

- Stereo provides a powerful means of examining multi-dimensional data sets.
- To go beyond expensive, specialized “virtual reality” devices we need simple extensions of 2-D software that runs on ordinary workstations with a natural 3-D interface.
- Stereo makes meshes and glyphs useful for visualization, allowing the user to see into 3-D volumes and rapidly understand vector data.
- These tools need to be merged with commercial programs to be more useful and robust.